Green (J. Orne)

CASES OF FATAL OTORRHŒA.

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FIVE CASES OF FATAL OTORRHŒA, WITH REMARKS ON THE COURSE BY WHICH SUCH CASES LEAD TO DEATH.

By J. Orne Green, M. D., of Boston.

The accompanying cases are submitted to the Society as contributions to the pathology of the ear.

For the opportunity of witnessing the following autopsy and dissecting the specimen I am indebted to the kindness of Dr. Francis Minot. The history is taken from the hospital records.

I. B., aged 28, pedler; entered the Massachusetts General Hospital, on May 12, 1869. Both parents were phthisical. He himself had always been well till two years ago, when he had an abscess under the right jaw, referred by him to a carious tooth, but more probably due to an inflammation of the tympanum. At the same time a discharge began from the right ear, which has continued ever since, but given him no special inconvenience. In October, 1868, after exposure, had pleurisy, and ever since has had a cough, with occasional bloody expectoration.

On May 2d, after a long walk in the rain, the muscles of the right side of face became paralyzed, and this was soon followed by general pain on the right side of head. Ten days after, he entered the hospital, complaining of constant vertigo and pain on the right side of head, but was able to be about. All functions natural. Pulse 96.

May 17th.— Pain in head continued severe, keeping him awake at night. Towards morning, without marked chill, a heavy cold sweat with nausea, and followed by considerable prostration.

From this time to the 22d, vomiting was very frequent, but then ceased; the pain in the head continued severe, and could not be relieved by any opiates.

23d.— A careful examination showed that all parts sup-

plied by the right facial nerve were completely paralyzed. The hypoglossal was also affected, for the whole body of the tongue when protruded, was pushed to the right side, but the tip could be moved freely from side to side. Sensation was good. The right arch of the palate was higher and rounder than the left; the uvula was slightly inclined to the left.

24*th*.— The pain in the head was for the first time relieved by a subcutaneous injection of sulphate of morphine, gr. ¼. There was some delirium.

25*th*.— The delirium had increased, and there was great restlessness at night; which was relieved, however, by morphine, gr. ¼, subcutaneously.

26*th*. — Became gradually comatose, the respiration shorter, and without any new symptoms, he died.

The autopsy, six and one-half hours after death, by Dr. John Homans, revealed as follows: —

"The right external auditory meatus filled with pus.

"*Head:* convolutions of brain universally flattened; arachnoid rather dry, fluid opaque. Both ventricles contained an unusual amount of fluid which was opaque, and, at depending portions, purulent. Membranes of the right half of Pons Varolii, covered with a grumous deposit, and the substance of the lower part of Pons, and of the corresponding olivary body was broken down nearly to the wall of the fourth ventricle. Substance of the right half of cerebellum destroyed to the depth of three-fourths of an inch. Tissues in the neighborhood of the ventricles much softened. The base of the brain covered with a purulent deposit which extended forwards to the optic commissure, and over to the left side of Pons.

"*Thorax:*—Many old pleuritic adhesions.

"*Lungs:*— Tubercular masses in both.

"*Abdomen:*— Tubercular masses in peritoneum. Many tubercular ulcerations of the large intestine."

Dissection of the petrous bone. The meatus internus filled with pus, and the dura mater on its edges for the dis-

tance of half an inch dissected up, leaving the bone bare but not carious. On washing away the pus, the facial and auditory nerves at their exit from the meatus were distinct and apparently not affected. At the orifice of the aqueductus vestibuli, on the posterior aspect of the petrous portion of the bone, the dura mater was bulging for a space half an inch in circumference, and pus was exuding through a small opening.

Lateral and petrosal sinuses were not affected. No caries of the bone at any point.

Roof of tympanic cavity unusually thick: this was removed and the cavity found filled with muco-purulent matter; the mucous membrane lining it was much swollen and of a livid color. Malleus whole and distinct, but no signs of the incus.

The cavity was then opened by sawing through the whole bone. The membrana tympani was much thickened by hyperæmia and swelling of its mucous lining, and was perforated both anterior and posterior to the manubrium, the anterior perforation being the larger. The malleus was normal and in normal position, but completely buried in the swollen mucous membrane. The mucous membrane of the promontory was so swollen as to nearly fill the depressions of the fenestræ, ovalis and rotunda. No traces of the stapes could be found. Thick, adhesive, purulent matter exuded from both fenestræ, and the vestibule was completely filled with it. The cochlea was opened, was free from pus, and appeared to the eye normal. On laying open the meatus internus, the facial nerve contained in it appeared normal, but the auditory nerve was discolored, and surrounded by and infiltrated with pus. The Fallopian canal in its passage through the tympanic cavity seemed to be only a groove, no bony wall separating it from the cavity, and the facial nerve was here only covered by the swollen mucous membrane. The inflammation had apparently not extended into the Fallopian canal. A microscopic examination of the facial nerve taken from the tympanic cavity showed no disorganization.

The semi-circular canals contained no pus, and appeared normal. The mastoid cells were few in number, but all contained purulent matter.

The extensive breaking down of the substance of the base of the brain on the right side, and the purulent deposit there, showed that this was the oldest spot and centre of the brain disease. The presence of pus in considerable quantity beneath the dura mater at the orifices of the meatus internus and aqueductus, and these collections only communicating with the interior of that membrane by small openings, indicated that the matter had collected there from the side next the bone, and had not penetrated from that next the brain. The bone not being carious at these points, it was necessary to look further; and following the pus into both these passages it is traced directly into the vestibule, which, from the destruction of the stapes, communicated directly with the tympanum. Further, the part of the brain disorganized was just along the course of the auditory nerve of the affected ear, and this nerve was found throughout its course discolored.

From these facts the source of the brain disease can be distinctly traced. From ulceration of the membrane around the stapes, the purulent matter of a chronic inflammation of the tympanum had penetrated the vestibule, and from here running along the only two passages communicating with the interior of the skull, had emerged at the aqueductus vestibuli and meatus internus, and thus set up a fatal meningitis. A portion of the infecting matter had also probably run along the auditory nerve.

The first symptoms in the case, aside from the otorrhœa of two years' standing, were paralysis of the facial nerve on the affected side, followed by constant dizziness, nausea, vomiting, and severe pain referred to the whole side of the head. After several days the vomiting ceased; the severe pain in the head could not be relieved by any remedies. The right hypoglossal nerve became paralyzed. The last two days of life he was delirious, and died on the twenty-fourth day from the beginning of the head symptoms.

H. G. H. W., aged twenty-two, a stout, healthy negro, entered the City Hospital, April 13, 1869, with a number of small superficial scalds on scalp and face. Three days afterwards, without known cause, he was seized with severe pain in right ear, soon followed by discharge. On examination at this time, I found an acute purulent inflammation of the right tympanum, with a small perforation on the anterior segment of the membrana tympani and a free discharge of pus. The inflammation was treated with leeches, syringing, and astringent instillations, and ran a very short and favorable course. The perforation, which had enlarged to one and a half lines in diameter, began to heal, and on May 12th he was discharged, to report as an out-patient; the perforation had contracted to the size of a pin-hole, the discharge had entirely ceased, and the hearing had been rapidly improving for several days.

On May 15th he returned, with severe pain in the ear and discharge, and reported that on the day of his discharge from the hospital, he laid on the damp grass and took cold. Examination showed the tympanum again intensely inflamed, and the perforation enlarged. He was immediately taken into hospital, and treated as before; but two days afterwards an otitis externa set in with so much swelling that the deeper parts could not be seen; in about ten days this had subsided and inspection then showed a perforation about two lines in diameter, through which a small polypoid growth, the size of a pea, protruded. This was removed close to the membrana tympani by means of the wire snare, and the base cauterized with pernitrate of mercury. Two days after, the whole base of the polypus, with the slough from the caustic on one side was washed out by syringing.

The discharge gradually ceased under treatment, the mucous membrane of the tympanum could be seen smooth and free from inflammation, the membrana tympani began to heal rapidly, and on June 2d he was discharged and ordered to report in two days, as an out-patient. No more was seen of him, however, till November 23d, when he gave the fol-

lowing account. Soon after leaving the hospital he went into the country, and was kept there for four months to work off an old debt, being obliged all the time to sleep in a barn. During this time he had a slight discharge from the ear, for which nothing was done. Two weeks ago he had severe pain in the ear, and a swelling formed in front of tragus: this pain has continued severe, and the swelling has increased.

He now has sharp, lancinating pains in ear, over the whole right side of face and head, difficulty in swallowing, and headache. There is a moderate discharge of thick pus from the meatus, and the whole of this passage is filled by a firm polypus with a red granular surface. He is much emaciated, feverish, with hot skin and rapid pulse. In front of the tragus is a swelling extending on to the cheek and down the neck, without fluctuation; only slight tenderness over mastoid process, and no swelling or redness. Appetite poor.

Leeches and blisters were applied about the ear, and narcotics ordered, *p. r. n.*

On Nov. 28th, dry râles were reported over both backs and there was a bloody viscid expectoration. Other symptoms same as on entrance.

Dec. 7th. — Pain in ear and head continued: complained of great vertigo, and vomited all food.

Dec. 8th.—I saw him for the first time since his re-entrance, at the request of Dr. Cheever; etherized him, and attempted to remove the polypus. The wire snare surrounding the growth was passed in as deeply as possible, and the mass cut off, apparently about one-fourth of an inch from the position of the membrana tympani. The walls of the meatus were covered by exuberant granulations. This operation was followed by such a rapid and profuse oozing of blood from the granulations and from the polypus, that it was impossible to remove more of the growth. With the probe, bare bone could be felt through the granulations. An incision was made into the swelling in front of the tragus, but no pus found.

Dec. 10th. — The pain in ear was less; purulent discharge

continued. Complained of sore throat and dysphagia. Liquid diet.

Different astringent instillations and caustics were tried to prevent the growth of the polypus and granulations, but without avail; the profuse bleeding prevented any further attempt to remove the polypus. The vertigo, vomiting, and pain, which were much relieved for a few days after the operation, returned with increased violence.

On January 3d, however, the vomiting had ceased, but the dysphagia had much increased, and on protruding the tongue it was drawn to the right side from paralysis of right hypoglossal nerve. Pain and discharge in ear as before. Under ether the swelling in front was freely incised by Dr. Cheever, but no pus found, and a seton was inserted over mastoid process. For the next week there was a slight improvement in the general symptoms, but there was occasional severe pain in ear, and the paralysis of hypoglossal remained as before.

On the 26th he began to fail rapidly. There was occasional epistaxis and obscured vision, but no difference in pupils. No new paralysis.

On the 28th, semi-conscious. Tongue dry; could not be protruded. No pain.

On the 30th he became profoundly comatose, without stertorous breathing; and, without convulsions, chills, or any new paralysis, died.

The autopsy by Dr. Webber showed in brief a general inflammation of the meninges of the brain, most severe at the base, with a large formation of lymph there. From the arachnoid covering the under surface of middle lobe on the right side, was a morbid growth resembling granulations: from the arachnoid of the right lobe of cerebellum was a similar growth through which the 9th, 10th, and 11th nerves passed; the 12th nerve was not implicated. A similar and larger mass covered the whole surface of the dura mater over the petrous portion of the right temporal bone, filling nearly the whole of middle fossa of skull and passing through the foramen ovale, carotid foramen and foramen rotundum to out-

side of skull. The lateral sinus was implicated in a similar growth and apparently obliterated. The tissues of the neck and around the ear were infiltrated with a purulent, grumous matter. The inner table of skull on right side was roughened as in the first stages of caries. A small portion of 12th nerve, external to the skull, was examined microscopically and found entirely degenerated, no normal fibres being seen; this being probably due to the pressure of the inflammatory products where the nerve had its exit from the skull.

The right temporal bone was removed and dissected. On removing the roof of the tympanic cavity, a polypus was seen attached to the promontory, and projecting into and filling the osseous meatus. The tympanic cavity contained much thick pus. No traces of any of the ossicula could be discovered. The internal ear was opened by sawing through the petrous portion of the temporal bone; the vestibule, cochlea and semi-circular canals were filled with a red, solid flesh-like mass, the membranous structures having been thus changed. The mastoid cells were filled with thick pus, and carious.

The mass described above on the dura mater projected slightly into the meatus internus, and also into the aqueductus vestibuli. The polypus grew from the whole surface of the promontory, and was attached to no other part of the tympanum. The granulations of the meatus, seen a few days before death, had entirely disappeared, and the whole internal surface of that passage was denuded of periosteum, and carious, and almost the whole anterior wall had disappeared. The walls of the carotid artery and jugular vein were thickened, but these vessels were pervious and contained no thrombi. The lateral sinus was not affected.

After maceration, the extent of the caries could be better seen. The entire wall of the meatus was carious, and a large part of the anterior wall had disappeared. The temporal bone, for the extent of one-half an inch around the meatus and the roots of zygoma were carious, being honeycombed by minute openings. The glenoid cavity was slightly carious,

as was also the superior surface of the petrous bone, and the wall of the lateral sinus. At the entrance of the aqueductus vestibuli, was a considerable loss of bone from caries. The walls of the carotid canal were carious. The entire floor of the tympanic cavity had been destroyed by caries, and no traces of the jugular fossa existed.

A microscopic examination of the masses attached to the dura mater, by Dr. J. C. Warren and myself gave a regular and imperfectly defined net-work of connective tissue, consisting of fibres mixed with numbers of small round cells, such as are seen in ordinary inflamed tissue; in the meshes of this stroma were larger cells, whose shape and appearance could not be made out, as the preparation had been hardened.

An examination of the polypus showed only a sarcomatous growth, such as is generally found in polypi from this position. The growths from the dura mater and the labyrinth were considered the result of inflammation, but their high organization is worthy of observation.

III. T. M., clerk, aged 22; was first seen by me on May 27th, 1870. At that time he was suffering from a purulent inflammation of the right tympanic cavity, with a small perforation of the membrane: the mastoid cells were likewise inflamed, and over them was a small abscess which had opened spontaneously a few days before. With a probe no caries could be felt.

He was prescribed for, and ordered to report in two days. He was not seen again till June 22d, when he reported that he had been confined to the house with severe pain in ear and head, and had been unable to work for four weeks. He was much emaciated, and was complaining of very severe pain in right ear and side of head. There was a free discharge of pus from the meatus; after cleansing, the membrana tympani was seen to be somewhat inflamed, and with a small perforation through which air could be blown by Valsalva's method. Over the right mastoid was a red, fluctuating, and painful swelling, size of a hen's egg. He was

immediately taken into the hospital; and, under ether, Dr. Thaxter made an incision two inches long in the abscess, evacuating a quantity of laudable pus; the incision was prolonged through the periosteum, but no bare carious bone was discovered. From this time I saw him occasionally, with Dr. Thaxter.

On the 23d, the next day, the pain in ear was inconsiderable. Syringing, and the instillation of sulphate of zinz, gr. ij. ad ʒi. ordered for the tympanum.

27*th*. — The discharge from meatus was diminishing, but there was some pain and tenderness over the mastoid. ℞. Tr. Ferri Muriatici gtt. x. t. d.

July 1*st*.— The inflammatory induration from mastoid was extending down neck, but was not tender. Appetite improving; wound healing.

6*th*. — He was first reported to complain of periodical pain and tenderness over occiput, coming on at 6 P. M. Wound over mastoid closing. Pulse 94. Was ordered Quinine, gr. viij. in gr. ij. doses, in the afternoon.

8*th*. — Less pain and tenderness over occiput. The induration of neck had extended further towards opposite side, was red, sensitive, but without fluctuation. P. 84. Some swelling of eyelids. Urine normal. Appetite good. On account of constipation an enema was ordered.

14*th*. — The swelling of neck had increased in size, was painful, fluctuating, and gave him difficulty in swallowing. P. 100.

Under ether, an incision 1½ in. long was made below right mastoid, and a considerable quantity of pus evacuated. Another incision 1 in. long was made on the anterior edge of mastoid and pus again found; through the two wounds a seton was then passed. The pus was found to have burrowed quite extensively in the neck.

16*th*. — Pain in neck entirely relieved since operation. The occipital pain however continues, requiring subcutaneous injections of sulphate of morphine, gr. ⅓. The sputa for several days have been noticed to contain pus, probably due

to the discharge of matter from the ear through th Eustachian tube, as examination of the lungs by Dr. Knight reveals no disease there.

For the next week the pains in the occiput were very severe at times, usually much worse about 4 P. M. Relieved by morphine subcutaneously. The general condition became worse. The pulse varied from 84–94.

On the 27th, he began to improve again; and on 29th pain in head was much less; he could sleep without opiates, and was able to walk about the ward. The seton was removed.

Aug. 2d. — The pain in occiput again returned, of the same character as before; on the 6th it had extended, and was referred to the whole surface on both sides, from occiput to forehead. ℞. Syr. Ferri, Quiniæ et. Strychniæ, ʒj. t. d.

The condition of the ear had, apparently, somewhat improved; the inflammation and discharge were less; there was no pain in the ear; the wound over the mastoid had healed without any caries having been discovered; the perforation of the membrana tympani remained as at first.

On account of my absence from the city I did not see him after this, and the remaining history is from the hospital records.

The pain in the head increased, and by the 14th he required subcutaneously, morphine gr. $\frac{1}{8}$ and atropine gr. $\frac{1}{50}$. Pulse varied from 68–90. Strength continued fair. He then began to complain of a tender spot over occipital protuberance, and after each meal vomited. Was ordered brandy and egg-nogg.

By the 23d $\frac{2}{3}$ gr. morphine were required to relieve pain. A small tumor, size of a pea, which had formed above occipital protuberance was incised, and a minute quantity of pus evacuated. The wound over mastoid had healed.

℞. Ext. Aloes, Alcoholic.

" Belladonnæ, āā gr. $\frac{1}{4}$, daily.

27th.— Pain in head and vomiting continued. Pulse 80, regular. Only liquid diet could be retained.

℞. Iodoform.

Ferri Carbonatis, āā gr. ij. t. d.

Sept. 1*st.* — Pain in occiput much increased. The wound in the neck which had closed to a mere sinus, but had continued to discharge freely, then became dry; a probe could be inserted for two inches, but no caries could be felt. P. 90.

4*th.*— The pain in head had much increased during last three days. At two P. M., was found in a semi-comatose condition, but moving continually. Pupils sluggish and contracted. Pulse 80. Respiration 10.

Evening.—Moaning and vomiting often. Comatose. No pulse at wrist. General tonic convulsions, lasting ten minutes, and then died. No autopsy.

On being received into the hospital, he was apparently suffering from a very severe inflammation of the middle ear only, with abscess over the mastoid; the brain symptoms were not present. On opening the abscess the bone was not softened or carious, nor did it become so later. The inflammation in the ear seemed to be doing well, the pain was very much less, and the discharge from the tympanum was diminishing till fifteen days after entrance when, without any appreciable change in the ear, he began to complain of pain in the occiput, which seemed to yield to quinine, and was thought at the time to be neuralgic. Inflammation in the neck followed. The occipital pains returned for ten days, then ceased so that he was about the ward. The pains then returned all over the head, accompanied by vomiting; both these symptoms continued, the pain increased rapidly in intensity during the last few days of life, and he died in general tonic convulsions, eleven weeks after entrance. His strength continued fair till one week before death, when it failed rapidly.

The diagnosis would seem to be either meningitis or abscess of the brain, the purulent matter probably penetrating in some of the ways to be described.

IV. T. A. F., aged 21, had always been considered healthy, with the exception of occasional trouble in right ear, to which he had paid little attention. The early history of the ear

disease is imperfect. For fourteen years he had had occasional pain and discharge: two years ago, at the same time that there was a discharge from the meatus, an abscess formed behind the ear, was opened and healed. For four weeks before entering the City Hospital he had been confined to the bed from very severe pain in head and ear, attended by great prostration; there had also been a purulent discharge from the meatus. A few days before entrance, a large polypus had been removed from the meatus.

On April 7th, 1870, he entered a private ward of the hospital under the care of Dr. J. G. Blake. He was then very weak and much emaciated; in bed, complaining of severe darting pains over right side of head, with constant headache on right side. There was a purulent discharge from the meatus and some swelling below and around auricle. His intellect was clear. Pulse 70, regular. Tongue coated. No appetite. Bowels constipated.

Ordered ice bag to head. Ear to be kept clean by syringing. Bromide of potass. gr. xx every three hours. Liquid diet.

8th. — Pain same. The bromide was omitted and chloral hydrate, gr. xx every three hours, ordered. The polypus had grown so rapidly as to be seen externally, and the swelling around the ear was increasing.

9th. — I saw him in consultation with Dr. Blake. The whole meatus was then completely filled with a firm polypoid growth, and it was immediately proposed under ether to remove this as thoroughly as possible. The patient's mother refused her consent, however, and would only allow the removal of the external portion without any anæsthetic. This was done and the growth cut off with the wire snare at about the middle of the meatus, and the remainder touched with nitrate of silver. An instillation of sulphate of zinc gr. v. ad ℥j., and three leeches on the swelling below the ear were ordered.

10th. — The swelling and tenderness below the ear were much diminished. Headache continued severe, but the

patient was less dull and stupid and the appetite was very much improved.

12*th*. — The pain in head continued as severe as ever, and morphine subcutaneously was ordered (gr. $\frac{1}{3}$ *p. r. n.*)

13*th*. — Some relief to headache from the morphine. Some redness and swelling of lobe of ear and over mastoid. Polypus grows as fast as it can be destroyed by the caustic, and there is a free, very offensive purulent discharge from the meatus. Poultice over mastoid.

15*th*. — Has become much more dull, aroused with difficulty, but intelligence fair. Appetite again good. Pulse 80, of fair strength. Tongue coated, but moist.

18*th*. — Little brighter, but more restless. Less headache. Takes nourishment well. Some cough with slight expectoration.

20*th*. — Distinct fluctuation behind ear, and by incision ʒss. pus evacuated; a probe passed in to the depth of two inches and the bone was felt to be extensively bare.

22*d*. — Very little pain in head or ear. Eats well. Bowels regular. Pulse 80, dicrotic. Only semi-conscious, gets out of bed, and walks about staggering. Discharge from wound entirely ceased: that from meatus diminished. With the probe the walls of the meatus were entirely denuded and probably carious. As a last resort in consultation with Drs. J. G. and C. J. Blake, it was proposed to establish an opening through the mastoid cells with the tympanic cavity, remove the whole of the polypus and so get a free communication through which water could be syringed and the pus washed out. This was refused by the mother, and the patient removed from the hospital the same day.

As I learned from the attending physician, the brain symptoms became more marked; he lost consciousness, became weaker, and without any chills, nausea, vomiting, convulsions, or paralysis, died on the fourth day after leaving the hospital. No autopsy was allowed.

For the specimen of the next case I am indebted to Dr.

Geo. E. Francis, of Worcester, who made the autopsy. The history is imperfect; the following are all the facts that could be obtained: —

V. A man, aged 25, subject to catarrh, and called by the family scrofulous. For two years he had been subject to what was called "abscess of the ear," resulting in the discharge of pus, which would last some weeks, and which was attended by deafness of both ears. Two months before death he consulted Dr. H. Clarke, of Worcester, for deafness so extreme that communication by writing was required. Shortly after, he showed cerebral symptoms, dizziness, headache, double vision, and partial paralysis; but of what regions is unknown. He was confined to his bed, and the hearing power is reported to have improved somewhat. He died comatose, and at the autopsy a collection of pus was found in the brain, just over a carious spot communicating with the tympanum. The pus lay directly upon the bone.

On laying open the bone a sinus was found through the upper osseous wall of the meatus, just above and external to the small process of the hammer. This opening was large enough to admit the point of an ordinary probe, and communicated with the meatus externally, and with the small cavity in front of the head of the hammer internally. From this cavity it passed backwards and inwards towards the mastoid process, into a circular cavity about ¼ in. in diameter in the cancellated structure of the bone, and the roof of bone over this cavity had entirely disappeared, so there was a direct communication with the brain. All the walls of this cavity were irregular and carious. The membrana tympani was entire and apparently healthy, of normal transparency and thickness in every part below the small process of the hammer. From the manner in which the bone had been opened the insertion of the upper edge of the membrane had been removed, so that it was impossible to speak of the condition in which the so-called membrana Shrapneli was, whether whole or perforated. The head of the hammer and the whole incus were wanting, but whether lost from disease, or during the dissection, cannot be said.

The point of interest in the case is the peculiar caries of the bone, associated with an unperforated and apparently healthy membrana tympani, the caries in the cancellated structure of the bone having destroyed the wall of the meatus on one side, and the roof which separated it from the brain on the other, and yet not having communicated with the tympanic cavity, or injured the membrana tympani.

The possibility of such accidents as occurred in this case can be easily explained by looking at sections of a normal bone, where it will be seen that but a thin lamina of firm bone separates the cancellated structure from the cavity of the skull on the one side, and from the meatus on the other. The small cavity, a part of the tympanum, above and external to the head of the hammer, it will be seen is separated from the meatus by an extremely thin lamina of bone; and within two years Tröltsch has directed especial attention to this cavity by a specimen which he dissected, and in which he found this plate of bone perforated, and through the perforation a polypoid growth from the mucous membrane projected into the meatus.

That a purulent inflammation of the tympanum could be fatal, without perforating the membrana tympani, was proved in a case of Tröltsch's, in which the roof of the tympanum was opened, and a fatal meningitis set up, and yet the membrana tympani remained entire. This case which I have described is, however, as far as I know, the only one recorded where a caries communicating with both the meatus and the brain had proved fatal without injuring the membrana tympani, and is of importance when we consider how little would have been seen during life by examination, and how necessary it is to bear in mind the possibility of such perforations of the wall of the meatus in searching for the source of a purulent discharge in the meatus.

REMARKS.

That a purulent discharge from the ear might in some rare cases cause necrosis of the bone in which that organ is im-

bedded, and that this necrosis might cause fatal trouble in the brain, has been recognized for a very long time by pathologists. That such a purulent otitis might become the direct cause of death without the bone becoming diseased, has been known only of late years. The dissection of pathological specimens has, however, shown that necrosis is not the only thing to be feared in these cases, but that even if the petrous bone is unaffected, the disease of the ear may be the direct cause of death.

The anatomical relations of the ear, as shown by the most recent investigations, prove that the ear is in more intimate connection with the brain and other important parts than had been supposed. By means of the microscope and fine injections it has been shown that the numerous small foramina with which the petrous portion of the temporal bone is perforated, furnish passages through which an inflammation may extend *ex contiguo* to other parts.

The whole upper and inner surfaces of the bone lie in direct contact with the meninges of the brain, being covered with the dura mater which here serves as a periosteum and nourishes the bone. Part of the upper surface forms the roof of the tympanum, is variable in thickness, but frequently so thin as to be nearly transparent.

The lateral sinus, a fold of the dura mater, and like it serving as a periosteum, is only separated from the mastoid cells by a thin lamella of bone through which many minute foramina pass directly into the cells. These mastoid cells form part of the tympanum. The facial nerve, in its Fallopian canal passes directly through the tympanum; is never separated from that cavity by more than a very delicate bony plate, and frequently from a deficiency in this, probably due to an arrest of development, lies in direct contact, with the mucous membrane lining the tympanum.

The floor of the tympanum is formed by the jugular fossa, in which lies the internal jugular vein; in this floor is a foramen, through which a branch of the vagus passes into the tympanum. Occasionally here, also, from an arrest of

development, the coverings of the jugular vein lie in direct contact with the mucous membrane of the tympanum. The anterior wall of the tympanum is formed by the carotid canal, is so thin that light passes readily through it, and is moreover perforated by foramina, through which the tympanic branches of the sympathetic pass from the carotid plexus to the tympanum.

The meatus internus gives a large canal from the cavity of the skull to the labyrinth of the ear, and this latter is only separated from the tympanum by the thin membranes covering the fenestræ, ovalis and rotunda. This large passage is lined by a prolongation of the dura mater, which serves as its periosteum. The aqueductus vestibuli also connects the interior of the skull with the cavity of the labyrinth, and serves for the passage of a small vein.

The petrosal-mastoid canal leads from the mastoid cells to the interior of the skull, thus furnishing still another communication from a different part of the tympanum to the brain. It serves for the passage of a vein which has been followed into the superior petrosal sinus so that we have here the circulation of the tympanum in direct communication with that of the meninges of the brain.

Without speaking of the different forms requiring various modifications of treatment, all of the serious otorrhœas consist essentially of a purulent inflammation of the mucous membrane lining the tympanum with a marked tendency to ulceration. This ulceration may, and usually does destroy the membrana tympani, making the meatus and tympanum one cavity, and it may destroy either or both the membranes of the fenestræ leading to the labyrinth thus exposing that cavity. From these two cavities, tympanum and labyrinth, we have seen that there are various avenues leading to the brain and other important parts. The ulceration is liable to attack the bone, causing absorption; and we have seen that but a very thin osseous plate separates the tympanum from the carotid canal, the jugular vein, the transverse sinus, and the facial nerve, and these bony plates, even in their normal condition, are perforated by foramina.

An examination of the recorded cases shows that all of the relations of the ear which I have mentioned are attended with danger. By far the most frequent accident seems to be a perforation of the thin roof of the tympanum and the extension of the inflammation *ex contiguo* onto the dura mater, causing a meningitis or suppuration of the substance of the brain directly above the perforation. The penetration of the purulent matter into the labyrinth by ulceration through the fenestræ and thence along the meatus internus or aqueductus vestibuli, is also a not infrequent cause of meningitis or abscess of the brain. Tröltsch moreover records a case where a fistula had been produced by ulceration directly through the bone from the tympanum into the labyrinth, without destruction of the membranes of the fenestræ, and thence the inflammation had extended to the brain, the patient dying of meningitis of the base.

The petrosal-mastoid canal would undoubtedly on examination be found a more frequent source of communication than is supposed. Voltolini has described a case, fatal from purulent meningitis, in which this canal was much enlarged from inflammatory softening and the dura mater around it intensely inflamed. He was not at that time aware that this passage conveyed a vein to the petrosal sinus, and no mention is made of the condition of the sinus. Tröltsch has also given a case where the inflammation extending along this passage had caused phlebitis of the superior petrosal sinus, and this had given rise to a pachymeningitis and two abscesses in the brain.

Occasionally the transverse sinus becomes inflamed from the mastoid cells, and Tröltsch found this sinus filled with a thrombus which had led to metastasis in the lungs. Hæmorrhage from this sinus, either external into the tympanum and meatus or internal into the cavity of the skull, has occasionally occurred from an extension of an inflammation from the mastoid cells, and Wreden has described a case fatal from two perforations of this sinus, through one of which the hæmorrhage was external and through the other internal; he

has likewise given a synopsis of eighteen such perforations from various authors.

An inflammation of the jugular vein may occur in the same manner as in the transverse sinus, the inflammation extending from the tympanum through its floor to the jugular fossa. In Virchow's lecture-room some years ago, I remember seeing a very marked case of this kind, where the floor of the tympanum was largely perforated and the internal jugular vein intensely inflamed and filled with a large thrombus which had led to metastatic deposits in different internal organs. The inflammation here may also take an ulcerative form, and the vein thus be perforated, causing a venous hæmorrhage through the external meatus or Eustachian tube.

The carotid artery is liable to the same injuries as the jugular vein and transverse sinus. It has been found inflamed and obliterated by a firm clot, and quite a number of cases are reported where it has been perforated, and the patients have died from arterial hæmorrhage. In a few cases where such a hæmorrhage occurred and the lesion was diagnosticated, ligature of the common carotid was performed with success.

Affections of the facial nerve from inflammation of the tympanum are by no means rare; the absence or perforation of the thin plate separating the Fallopian canal from that cavity, allowing the inflammation to extend along the sheath of the nerve, or else allowing the swollen mucous membrane to press directly on the nerve, causing a paralysis of all the parts supplied by it. So far as I know, however, no cases are reported of an extension of the inflammation along this passage to the brain.

In addition to these different forms of disease in which the connection with the ear can be distinctly traced, it is now generally accepted that any suppuration may be the exciting cause of pyæmia, and that an inflammation of the substance of a bone is especially liable to lead to this. One or more abscesses in the brain, remote from the ear and surrounded by healthy tissue are sometimes found, for which no other

cause than a suppuration of the ear can be discovered, and Tröltsch with other writers have considered that the circulation was the channel which carried the exciting cause of the abscess, be it a minute embolus or putrid matter, from the ear. On this subject Tröltsch remarks: —

"Not only the true diplöe, but the bone of the os temporis in general is in direct connection, by means of its blood-vessels, with the dura mater on the one hand, and with the soft parts of the ear on the other. The temporal bone in general receives its vessels from within and from without, and also sends them in both directions, not only to the dura mater, but also to the membranes lining the outer and middle ear. Diseases of the latter produce abnormal conditions in the bone and its vessels, which either through the contents, or along the tissue of the walls of the blood-vessels pass onto the dura mater, and there call up secondary pathological processes. These announce themselves in the one case as purulent inflammations of the brain membranes or of the walls of the sinuses, in another by clot-formation and closure of the caliber of the vessels, or by the entrance of putrid matter into the circulation. That all these processes developing themselves within or on the vessels, can be produced by the purulent inflammation of the soft parts of the ear without the existence of a 'caries of the petrous bone' cannot often enough be impressed upon the practitioner, since many are inclined to fear only a 'caries of the petrous bone,' not, however, a simple otorrhœa or purulent inflammation of the soft parts of the ear."